



Swamps and Marshes

Wetlands are the most productive ecosystems in the world, home to many specially adapted plant and wildlife species. Although most of Missouri's wetlands have been destroyed, wetlands provide many important ecological services.

Estimated Time

Three 50-minute
class sessions

Technology Tools/Skills Used in Chapter

- Soil saturation testing
- Invertebrate sampling technique for assessing water quality
- Invertebrate identification using a dichotomous key

Safety Precautions/Concerns

None

Vocabulary

Anaerobic
Detritus

Chapter Objectives

Students will be able to:

1. Compare and contrast swamps and marshes.
2. Explain how biotic and abiotic factors that make up wetland ecosystems function together.
3. Compare and contrast the adaptations of plants and animals living in wetlands to those of other aquatic and terrestrial species.
4. Diagram and describe the transfer of energy in marsh food web.
5. Predict the impact of channelization/drainage on the organisms in a wetland ecosystem. Describe how technological solutions to problems, such as drainage and agricultural development, can have risks and unintended consequences. Describe possible solutions to potentially harmful environmental changes within a wetland ecosystem.
6. Assess the health of a wetland based on the presence or absence of aquatic invertebrates.

Targeted Grade-Level Expectations

EC.1.A.6.a.
EC.1.B.6.a.
EC.1.B.6.b.
EC.1.B.6.c.
EC.2.A.6.a.
EC.2.A.6.b.
EC.1.D.6.a.
EC.1.D.6.b.
EC.1.D.6.c.
IS.1.C.6.a.

Reference Material for Teacher Background

- African Clawed Frogs (SCI013)
- Critter Cards: Benthic Macroinvertebrates (STR295)
- DVD Compilation for *Conserving Missouri's Aquatic Ecosystems*
- Introduction to Crayfish (FIS011)
- Introduction to Missouri Fishes (FIS020)
- Know Missouri's Catfish (FIS003)
- Life Within the Water (FIS034)
- Missouri Aquatic Snails (SCI017)
- Missouri Marsh Birds (E00042)
- Missouri Toads and Frogs (E00430)
- Missouri Turtles (E00468)
- Missouri Wetlands (SCI149)
- Missouri Wetlands & Their Management (SCI150)
- Nuisance Aquatic Plants in Missouri Ponds and Lakes (FIS110)
- Plants for Wetland Habitat (SCI008)

- Poster: Aquatic Invasive Species (FIS029)
- Poster: Exploring Missouri Wetlands (E00003)
- Poster: Missouri Fishes (E00013)
- Poster: Salamander (E00089)
- Poster: Toads & Frogs (E00012)
- Poster: Wetlands & Waterfowl (E00115)
- Stream Insects/Crustaceans ID (STR250)
- *Crayfishes of Missouri* (01-0250)
- *Fishes of Missouri* (01-0031)
- *Amphibians and Reptiles of Missouri* (01-0190)
- *Pond Life: Revised and Updated (A Golden Guide from St. Martin's Press)* by George K. Reid
- *WOW! The Wonders of Wetlands*

Required Materials

- 30 wooden stakes approximately 4 foot in length, or music stands, or masking tape
- Chalk, plastic non-adhesive survey tape or spray paint outside, or vinyl electrical tape, string or plastic non-adhesive survey tape indoors
- DVD Compilation for *Conserving Missouri's Aquatic Ecosystems*
- Garden spades or shovels
- Notebook paper
- 1 copy of Soil Sampling—Percolation and Characteristics for each student
- Pens or pencils
- Poster: Exploring Missouri Wetlands (E00003)
- Pushpins or thumbtacks
- Red, green and black yarn
- Rulers
- Scissors
- *A-Mazing Macroinvertebrates* signs on paper or cardstock and laminated or placed in plastic sheet protectors
- Stopwatches, watches or clocks
- Student Guide
- TV/DVD player

Activity 9.1: Exploration of Students' Current Understanding of Missouri's Swamp and Marsh Ecosystems

This activity explores students' current understanding of Missouri's swamp and marsh ecosystems.

Estimated Time

15 minutes

Required Materials

- Poster: Exploring Missouri Wetlands (E00003)
- Notebook paper
- Pens or pencils

Procedure

1. Display the Exploring Missouri Wetlands poster in the classroom.
2. Ask students to use their notebooks to free-write, brainstorm, mind-map or cluster for five minutes everything they know about swamps and marshes. Lead class discussion by asking each student to contribute something to the board without repeating an item. Have students add to their notebooks any information on the board that they hadn't already included. Leave these items on the board for use in Activity 9.2.
3. Explain to the class that this chapter will help them understand what a wetland ecosystem is and how it functions.

Activity 9.2: Video Exploration of Missouri's Swamp and Marsh Ecosystems

This activity helps students understand Missouri's swamp and marsh ecosystems.

Estimated Time

35 minutes

Required Materials

- DVD Compilation for *Conserving Missouri's Aquatic Ecosystems*
- TV/DVD player
- Notebook paper
- Pens or pencils

Procedure

1. Show the video: "Southeast Missouri." Pause the video frequently and discuss facts, concepts and misunderstandings students wrote on the board in Activity 9.1 as they arise in the video.
2. Have students make notes in their science notebooks.
3. As time permits, show one or more of the video clips: "Winter Hike (Dresser Island Wetland)," "A Day on a Marsh" and "Grand Pass Conservation Area."

Activity 9.3: Student Reading and Research

This activity provides students with definitions and explanations about Missouri's wetland ecosystems.

Estimated Time

Varies—class time may be provided or reading may be assigned as homework. Allow at least 20 minutes for in-class questions and discussion.

Required Materials

- Student Guide
- Notebook paper (optional)
- Pens or pencils (optional)

Procedure

1. Have students read Chapter 9: Swamps and Marshes. Introduce vocabulary terms as needed.
2. Assign the **Questions to Consider** as homework or use them in a cooperative learning activity.
 1. What is a wetland? What three factors must be present for a place to be considered a wetland?
Wetlands are places where the land and water meet. In a wetland, the soil is saturated or covered with water at least part of the year. Staying wet gives the soil unique properties. In those places, the wet land becomes a home to plants that are specially adapted to live in saturated soil.
 2. What are the main types of wetlands found in Missouri? What are the differences and similarities between them?
Missouri has two main types of wetlands: marshes, where reeds and other grasslike plants grow, and swamps, in which woody species (trees and shrubs) thrive. All wetlands are wet for a major part of the growing season (spring and summer). Some wetlands may have standing water. Others may only appear slightly muddy, or may even seem dry at the ground's surface. But dig a hole and it will fill with water very quickly. The soil holds water like a sponge.
 3. What is different about wetland soil? How does it get that way? How can we recognize it?
When soil is saturated the space between the bits of dirt is filled with water. This leaves little or no room for air, giving the soil a grayish color and a gooey texture. In the water, tiny creatures break down dead plant and animal matter called detritus. Because the detritus layer settles beneath the water and is not exposed to air, special kinds of decomposers are needed. Anaerobic bacteria, which do not need oxygen to live, are the stars of the wetland ecosystem. As they break down the detritus, they produce sulfur-containing compounds. The sulfur compounds smell like rotten eggs. But the smell tells us the wetland is healthy. The rich detritus nourishes a complex food web.
 4. What are some examples of the special adaptations found in wetland plants?
Wetland plants are adapted to take advantage of every ray of sunlight. They have special ways to expose their leaves to the sun and avoid being shaded by other leaves. They also have roots that can pull in water and still get air, too. Plants that grow in shallow water have roots that grow in the mud and hold onto silt. Most of these plants are tall because they have greater support, enabling them to rise above other plants to reach the sun. Cattails, buttonbush, rushes, sedges and arrowheads do this very well. Other plants such as water lilies grow in deeper water but are still anchored. Plants such as duckweed grow in open water to avoid the shade of taller plants, but they float by using air spaces in their leaves. Their short roots hang free in the nutrient-rich water. Another challenge of wetland plants is how to get enough air for their cells. The cypress tree's roots (called knees) extend up and out of the water. Sedges and rushes have air spaces inside their leaves to take oxygen and carbon dioxide to the roots.
 5. How are wetlands important to Missouri's fish, birds, and other wildlife?
Wetlands are home to many invertebrates, amphibians, reptiles, fish, birds and mammals. In fact, you can find more animals and plants in an acre of wetland than in any other kind of ecosystem. In fact all freshwater fish are partially dependent on wetlands. Young fish can find protection from larger fish and

other predators by staying in the plant-filled shallow water of wetlands. Nutrients are available in the detritus in forms that small fish can use. Wetlands are the main habitat for furbearing animals, like beaver, otter and muskrat. More than a quarter of our nesting and migratory birds depend on wetlands for part of their life cycle. Missouri's wetlands serve the vital function of providing migrating waterfowl a place to rest and replenish energy reserves lost in flight. Predatory birds such as osprey, bald eagles, kites, hawks, and owls also feed and nest in wetlands. Ducks, geese, swans and shorebirds rely on wetland habitats.

6. How do wetlands improve water quality?

Wetlands filter out pollutants. Wetland plants absorb pollutants, store them, break them down and in some cases even use them as nutrients. For example, excess plant nutrients from fertilizers reduce water quality in many streams and lakes. But because wetland plants can store these nutrients, they use them as fuel for growth. Bacteria found in wetlands can even break these chemicals down into harmless gases and release them into the atmosphere. Wetlands also improve water quality by cleansing runoff that comes from higher in the watershed. Because of their flatness and lush plant growth, wetlands slow the flow of water coming into them. In the slow water, suspended soil particles settle out. Wetland plants also filter particles from water, keeping sediment out of streams and rivers.

7. How do wetlands provide natural flood control?

Wetlands act as giant sponges. Their organic matter and specialized plants take in up to 18 times their weight in water. During periods of heavy rains or runoff, wetlands first hold water then release it slowly back into the watershed. By holding water and letting it go slowly, wetlands reduce the total amount of water going into lower watersheds. This reduces flood risk and peak flood volume downstream.

Activity 9.4: Student Investigation of Wetland Food Webs

This activity helps students understand wetland food webs.

Estimated Time

25 minutes

Required Materials

- Poster: Exploring Missouri Wetlands (E00003)
- Notebook paper
- Pens or pencils
- Red, green and black yarn
- Scissors
- Pushpins or thumbtacks

Procedure

1. Display the Exploring Missouri Wetlands poster in the classroom.
2. Have students take turns cutting lengths of yarn and using pushpins, attach them to the poster to diagram the food web connections between the plants and animals depicted in the poster. Tell students to use red yarn to connect a predator to its prey. Have students use green yarn to connect primary consumers to producers. Use black yarn to connect scavengers and decomposers to their food.
3. Lead class discussion of wetland food webs emphasizing the importance of scavengers, detritus and anaerobic decomposers.
4. Ask students to predict the impact of channelization/drainage on the organisms in a wetland ecosystem. (Drainage removes water—the most vital component of a wetland—from the ecosystem. If drainage is successful, the entire ecosystem and the organisms within it could be permanently lost.)
5. Have students write science notebook entries explaining how the biotic and abiotic factors that make up the wetland ecosystem function together, including the importance of the role scavengers, detritus and anaerobic decomposers play in wetland ecosystems.

Activity 9.5: Video Instruction for Invertebrate Sampling

This activity helps students understand the techniques used for invertebrate sampling. It helps students understand the use of biodiversity and indicator species to assess water quality.

Estimated Time

25 minutes

Required Materials

- DVD Compilation for *Conserving Missouri's Aquatic Ecosystems*
- TV/DVD player
- Notebook paper
- Pens or pencils

Procedure

1. Explain that, besides testing the physical and chemical characteristics of the water, water quality experts also look for certain invertebrates that live among the plants and in the bottom of the swamp or marsh. Examples include the immature stages of dragonflies, damselflies and mayflies. These insects are sensitive to pollution. The presence of such species generally indicates good quality water. When they are missing from a swamp or marsh or when only pollution tolerant species such as black fly larvae and bloodworms are present, we know that something is wrong with the water. Biodiversity—a high number of species—as well as a high number of sensitive species living in a swamp or marsh are good signs of its health. Explain that the video will show them how to sample a swamp or marsh for invertebrates. Finding a diverse group of invertebrates, including those that are sensitive to pollution, indicates that the swamp or marsh has high water quality.
2. Show the video clips: “Wetland Invertebrate Sampling.” Ask students to follow along on the instruction sheet as the different sampling methods are depicted. Pause the video as needed to clarify, discuss and review.
3. If desired, distribute copies of the Invertebrate Sampling Instructions and data pages (see Field Study Day section) for students to follow along with the video.

Activity 9.6: Student Investigation of Invertebrate Identification

Adapted from "A-Mazing Macroinvertebrates" by Rhonda Anderson, Missouri Department of Conservation

This activity helps students learn to identify invertebrates in preparation for their field study day. It helps students understand how to use dichotomous keys.

Estimated Time

25 minutes

Required Materials

- 30 wooden stakes approximately 4 foot in length, or music stands, or masking tape
- *A-Mazing Macroinvertebrates* signs (printed from a PDF on DVD Compilation for *Conserving Missouri's Aquatic Ecosystems*) on paper or cardstock and laminated or placed in plastic sheet protectors
- Chalk, plastic non-adhesive survey tape or spray paint outside, or vinyl electrical tape, string or plastic non-adhesive survey tape indoors

Procedure

1. This activity is a maze that uses a large open space such as a grassy field or a gymnasium. This activity lends itself better to outdoor situations, but it can be done inside when ample space is available.
2. Using a permanent marker, write the letter corresponding to the layout on the back of each sign. Write a corresponding letter on each invertebrate picture to allow the student to know if he or she has correctly identified the invertebrate.
3. For an outdoor set up, use 30 wooden stakes approximately 4 foot in length. Attach the signs with staples or velcro and drive stakes into the ground. For an indoor set-up, use music stands or tape the signs directly on the floor.
4. Make lines connecting the stations at right angles. Use chalk, plastic non-adhesive survey tape or spray paint outside or vinyl electrical tape, string or non-adhesive survey tape inside. Always ask permission to use spray paint before applying to grass of a public lawn. If using string or tape, be sure to place it close to the ground at each station to avoid tripping.
5. This key was designed for use with specific invertebrates. Pictures of the 15 invertebrates are included to ensure that the students are able to properly key them out. Each invertebrate should be labeled with letters corresponding to the sign. This way the students will be able to know immediately if they are correct. (Caution, some students will just look for the matching letter!) You will also be able to match the invertebrate to the answer key and know if the students are correct.
6. Walk through the maze with a couple of different invertebrates to insure that the maze is set up correctly.
7. Emphasize to students the importance of proper handling of the pictures to minimize wear. Review with the class the important points of invertebrate anatomy before starting. These include: head, thorax, abdomen, gills, wing pads, prolegs, segmented legs, and lateral filaments.
8. Allow students to select an invertebrate and review its anatomy. Explain any vocabulary words that may be unfamiliar to the students. The key to success is in looking at the correct body part for each clue.
9. Go over the first clue with the students and explain how to follow the maze. Tell them to read both options before making any decisions.

10. Each student should walk through the maze with the picture of the invertebrate in hand, making choices and eventually reaching a dead end—the name of their invertebrate.
11. Sometimes students will need correction on a selection. Encourage them to return to the start of the maze until their invertebrate is correctly identified.
12. Encourage students to select another invertebrate and repeat the process as time permits.
13. Students can be paired up to go through the maze. Students having problems can be reassigned a partner who has been successful at identifying several invertebrates.

Activity 9.7: Student Investigation of Soil Characteristics

This hands-on activity helps students understand soil characteristics.

Estimated Time

40 minutes

Required Materials

- Notebook paper
- Pens or pencils
- Rulers
- Garden spades or shovels
- Stopwatches, watches or clocks
- One copy of Soil Sampling—Percolation and Characteristics for each student

Procedure

1. Take the class outside. If possible, have students work in small groups in varying locations in order to compare results from different sites.
2. Provide each student with a copy of Soil Sampling—Percolation and Characteristics.
3. Lead the class through the procedure.
4. Have students compare their results and place the completed data sheets in their science notebooks.

SOIL SAMPLING—PERCOLATION AND CHARACTERISTICS

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Objective

Determine the soil percolation rate and observe the color, texture and odor of the soil.

Directions

1. If there is standing water at the site, use a ruler to measure the depth of the standing water. Measure in inches from the soil surface to the top of the water and record the result. If there is standing water, do not dig a test hole.
2. If there is no standing water at the site, dig a hole 12 inches square and 12 inches deep using a spade or shovel.
3. Measure the rise in water level during an approximate 30-minute period.
4. Calculate percolation rate in inches per minute and record it below.
5. While waiting, examine some of the soil from the hole. When soil is saturated the space between the bits of dirt is filled with water. This leaves little or no room for air, giving the soil a grayish color and a gooey texture. These gray, blue, even black wetland soils also may have irregularly shaped reddish-brown or orange-yellow mottles. Record your observations under color and texture.
6. In the water, tiny creatures break down dead plant and animal matter called detritus. Because the detritus layer settles beneath the water and is not exposed to air, special kinds of decomposers are needed. Anaerobic bacteria, which do not need oxygen to live, break down the detritus. They produce sulfur-containing compounds, which smell like rotten eggs. Remove a small piece of soil from the hole. Crush this piece between thumb and forefingers and smell it to determine if hydrogen sulfide is present. Record your observations.
7. Fill in your soil hole when done!

SOIL SAMPLING—PERCOLATION AND CHARACTERISTICS

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Group: _____ (names)

Date: _____

Location: _____

Water level change after 30 minutes: _____ inches.

Percolation rate = water level change after 30 minutes ÷ 30 = _____ inches per minute.

Soil Characteristics

Site	Depth of standing water (inches)	Percolation rate (inches per minute)	Color	Texture	Odor

Activity 9.8: Student Investigation of Wetland Soil

Students apply what they have learned in the preceding activities to create a data table to record soil sampling data and observations in preparation for their field study day.

Estimated Time

10 minutes

Required Materials

- Notebook paper
- Pens or pencils

Procedure

1. Instruct students to work in teams to decide the best way to record soil sampling data and observations as part of their field study day.
2. Have each team create a data table and have each student make a copy for his/her notebook.

Chapter 9 Assessment

Directions

Select the best answer for each of the following multiple-choice questions.

1. Which of these statements is true about Missouri wetlands?
 - a. Reeds and other grasslike plants grow in marshes, while woody species (trees and shrubs) thrive in swamps.
 - b. Reeds and other grasslike plants grow in swamps, while woody species (trees and shrubs) thrive in marshes.
 - c. Swamps and marshes have standing water all year round.
 - d. None of the above
2. Plants living in wetlands have:
 - a. Long, thin, flexible stems and strong root systems to hold them in place
 - b. Are tiny, free-floating species of algae and are the food base of the ecosystem
 - c. Roots that can pull in water and still get air
 - d. None of the above
3. Predict the impact of flooding on the organisms in a wetland ecosystem.
 - a. Some fish, plants or other aquatic life could be washed downstream.
 - b. There would be no long-term damage.
 - c. Fresh nutrients would be brought in.
 - d. All of the above
4. What three factors are required for a place to be considered a wetland?
 - a. Saturated soil, diverse plant and animal community, standing water
 - b. Saturated soil, diverse plant and animal community, plants specially adapted to live in saturated soil
 - c. Saturated soil, wet for a major part of the growing season, plants specially adapted to live in saturated soil
 - d. Standing water, wet for a major part of the growing season, plants specially adapted to live in saturated soil
5. What is detritus?
 - a. A complex web of relationships between living and non-living things
 - b. The variety and number of different organisms and populations, and the way they live together
 - c. Dead plant and animal matter in the process of decay
 - d. None of the above

Chapter 9 Assessment

Copy Page

Directions

Write your own answer for each of the following questions.

1. What is detritus? What are anaerobic decomposers? Explain how the biotic and abiotic factors that make up the wetland ecosystem, including detritus anaerobic decomposers, function together.
2. Technological solutions to problems can have risks and unintended consequences. Justify this statement by using the channelization/drainage of a Missouri wetland as an example.
3. Suggest a possible solution to potentially harmful environmental changes within a wetland ecosystem caused by the channelization/drainage of a Missouri wetland.

Chapter 9 Assessment Answer Key

Multiple-choice questions

1. Which of these statements is true about Missouri wetlands?
a. Reeds and other grasslike plants grow in marshes, while woody species (trees and shrubs) thrive in swamps.
2. Plants living in wetlands have:
c. Roots that can pull in water and still get air
3. Predict the impact of flooding on the organisms in a wetland ecosystem.
d. All of the above
4. What three factors are required for a place to be considered a wetland?
c. Saturated soil, wet for a major part of the growing season, plants specially adapted to live in saturated soil
5. What is detritus?
c. Dead plant and animal matter in the process of decay

Write-in questions

1. What is detritus? What are anaerobic decomposers? Explain how the biotic and abiotic factors that make up the wetland ecosystem, including detritus anaerobic decomposers, function together.
Detritus is dead plant and animal matter in the process of decay. Anaerobic decomposers are bacteria that do not need oxygen to live. Because the detritus layer settles beneath the water and is not exposed to air, anaerobic decomposers are needed. Anaerobic bacteria are the stars of the wetland ecosystem. As they break down the detritus, they produce sulfur-containing compounds. Nutrients are available in the detritus in forms that small fish can use. The rich detritus nourishes a complex food web.
2. Technological solutions to problems can have risks and unintended consequences. Justify this statement by using the channelization/drainage of a Missouri wetland as an example.
Answers may include:
Wetlands have a bad reputation. To some people, the word “wetland” means a stinky, bug-infested wasteland. Others think wetlands should be drained and put to “better” use. Most wetlands were drained to make the land farmable. In other cases, wetlands have been lost due to channelization to improve river navigation. Statewide, 87 percent of Missouri’s wetlands have been destroyed. Many of the wetlands that are left suffer from sedimentation, pollution and changes people have made. Missouri once had 4.5 million acres of wetlands, mostly along major rivers. The sloughs and oxbow lakes along the Missouri and Mississippi rivers are gone. So are the wooded swamps of southeast Missouri. Of the 2.4 million acres of swamp that once stood in southeast Missouri, less than 60,000 acres, or 2 percent, survive today. Southeast Missouri was once the part of the state with the most diverse and the most abundant wildlife. Today it has the least wildlife, and the least diverse wildlife. The water table continues to fall, leaving some areas of former swamp so dry they resemble desert and require irrigation for farming. While the swamps yielded valuable timber and have become profitable farms, the land continues to suffer.

3. Suggest a possible solution to potentially harmful environmental changes within a wetland ecosystem caused by the channelization/drainage of a Missouri wetland.

Answers may include:

Taking care of the wetlands that are left and putting some back are some of conservation's biggest challenges. In 1972, Congress passed the Clean Water Act, which gave strong protection to wetlands. After the floods of 1993 and 1995, areas such as Columbia Bottom near St. Louis and Big Muddy near Boonville were turned back into wetlands to provide flood control and wildlife habitat. But we have a long way to go toward bringing back these special places to Missouri. One of the best ways to protect the wetlands we have left is to understand how their many benefits serve us all. The future of Missouri's wetlands depends on citizens who value and enjoy them. To learn more about conserving Missouri's wetlands, visit the Missouri Department of Conservation's Web site. You can also visit your local Conservation Department office or a conservation nature center. Better yet, go outside and visit a wetland. Begin thinking of it as YOUR swamp or marsh. Always bring a trash bag when you visit, and take a moment to leave the spot in better shape than you found it. Follow the rules of ethical conduct in the use of aquatic resources and teach others to do so, too. Volunteer to become a Master Naturalist or Water Quality Monitor. And if you're up to the challenge, choose a career in conservation and make wetland conservation your life's work. Above all, enjoy your aquatic resources and use them wisely!

Enrichments

Project WET:

- Capture, Store, Release
- Life in the Fast Lane
- Wetland Soils in Living Color
- Macroinvertebrate Mayhem

Project WILD Aquatic:

- Dragonfly Pond
- Wetland Metaphors

Service learning:

- Storm drain stenciling
- Litter pickup

Guest speaker:

- Wetland ecologist

Electronic media:

- Duck wing maze DVD (Also requires duck wing collection borrowed from Missouri Department of Conservation staff.)
- Are You Still There? (Chicken Turtle) video clip